DSC#755

ULYSSES
JPL SEDR EPHEMERIS DATA
90-090B-00A

ULYSSES
SOLAR WIND PLASMA IONS
90-090B-05A

ULYSSES
SOLAR WIND PLASMA ELECTRONS
90-090B-05B

ULYSSES

JPL SEDR EPHEMERIS DATA

90-090B-00A

THIS DATASET CONSISTS OF ONE MAGNETIC TAPE. THE TAPE IS 6250 BPI, BINARY FORMAT, AND UNLABELED. CONTAINED IN THE DATASET CATALOG IS A DIRECTORYOF FILE NUMBERS WHICH CORRESPONDS WITH THE FILE NAMES FROM THE DISK DIRECTORY ANON_DIR: [COHO.ULYTRJ.SEDR]. THE D AND C NUMBER ALONG WITH IT'S TIME SPAN IS LISTED BELOW.

D#	C#	FILES	TIMESPAN
D-107969	C-031713	23	11/01/90-11/30/90 12/01/93-10/30/94

DATA AFTER NOVEMBER 1990 AND BEFORE DECEMBER 1993 HAVE NOT BEEN RECEIVED AT NSSDC

FILES ON UNLABELED TAPE AND THEIR NAMES FROM THE DISK DIRECTORY
ANON_DIR:[COHO.ULYTRJ.SEDR]

```
FILE  1     SEDR9011.FIX;1
FILE  2     SEDR9011.FLT;1
FILE  3     SEDR9312.FIX;1
FILE  4     SEDR9312.FLT;1
FILE  5     SEDR9401.FIX;1
FILE  6     SEDR9401.FLT;1
FILE  7     SEDR9402.FIX;1
FILE  8     SEDR9402.FLT;1
FILE  9     SEDR9403.FIX;1
FILE 10     SEDR9403.FLT;1
FILE 11     SEDR9404.FIX;1
FILE 12     SEDR9404.FLT;1
FILE 13     SEDR9406.FIX;1
FILE 14     SEDR9406.FLT;1
FILE 15     SEDR9407.FIX;1
FILE 16     SEDR9407.FLT;1
FILE 17     SEDR9408.FIX;1
FILE 18     SEDR9408.FLT;1
FILE 19     SEDR9409.FIX;1
FILE 20     SEDR9409.FLT;1
FILE 21     SEDR9410.FIX;2
FILE 22     SEDR9410.FLT;1
FILE 23     SEDRSIS.EPF;1
```

[illegible]

11/15/94 JFC

I. Ulysses Predicted Heliocentric Coordinates - Daily Values for 1990-1999

Data File: ULYTRJA.DAT

Data Parameters:

YY DDD RAD.AU SECLAT SECLON HELLAT HELLON HILLON

Parameter Description:

YY = YEAR
DDD= INTEGER DAY OF YEAR (1= JAN. 1)
RAD.AU= HELIOSPHERIC RADIAL DISTANCE IN AU
SECLAT= SOLAR ECLIPTIC LATITUDE IN DEGREES
SECLON= SOLAR ECLIPTIC LONGITUDE IN DEGREES
HELLAT= SOLAR HELIOGRAPHIC LATITUDE IN DEGREES
HELLON= SOLAR HELIOGRAPHIC LONGITUDE IN DEGREES
HILLON= SOLAR HELIOGRAPHIC INERTIAL LONGITUDE IN DEGREES WITH RESPECT TO ASCENDING NODE OF SOLAR EQUATOR ON THE ECLIPTIC

Data Source:

These data were obtained from running the program HELICOOR in the public directory NSSDCA::ANON_DIR:[ACTIVE.HELIO]. See [COHO]HELIO.DOC for information on codes and data in the [ACTIVE.HELIO] directory.These data are based on predicted trajectories calculated with the GTDS code by the NSSDC Satellite Situation Center and converted to solar ecliptic and heliographic coordinates by the HELIOCOOR program. The HELICOOR code was written by R. Parthasarathy. The program GENTRJCON added the HILLON longitude.

Note that the solar ecliptic coordinates are given with respect to true equinox and ecliptic of date. The solar ascending node was located at ecliptic longitude +74.367 degrees as of 1 Jan. 1900 at 1200 UT; this longitude increases by 1.4 degrees/century.

Note: A few glitches were noted before 7/22/94 in the coordinates for days 94/200 and 94/224. The HELICOOR and GENTRJCON codes have been rerun and these glitches have disappeared. Please advise nssdca::jcooper if any other problems become apparent through use of these data.

II. Ulysses Supplementary Experimeter Data Records (SEDR): Launch - Present

See directory [coho.ulytrj.sedr] for all SEDR data files and associated documentation submitted by the Ulysses project to NSSDC. The file suffix FIX is for integer format data and FLT is for floating point. One binary file of each type, FIX and FLT, is provided for each month of the mission (e.g., file SEDR0994.FLT contains floating point binary data for September 1994). The File SEDRSIS.EPF holds the SEDR documentation in postscript format.

SEDR files for data after Nov. 1990 and before Dec. 1993 have not yet been submitted to NSSDC.

628-306

ULYSSES

SOFTWARE INTERFACE SPECIFICATION

SUPPLEMENTARY EXPERIMENT DATA RECORDS to ULYSSES PRINCIPAL INVESTIGATORS

SIS 2sc

July 13, 1984
Revised September 22, 1994

ABSTRACT: This SIS describes the format and contents of the ULS SEDR and the medium and access methods for the SEDR. The SEDR contains information on the ULS Spacecraft orientation and trajectory and solar system geometries.

JPL
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Acknowledgement

Many people have made contributions to the current state of the Supplementary Experiment Data Record concept over a period of many years and for several projects. Those that have contributed to this Ulysses version include Harry Woo, Jody Gunn, Neil Toy, and Jim Schmidling.

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SEDR SOFTWARE INTERFACE SPECIFICATION

PRINCIPAL INVESTIGATOR CONCURRENCES:

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DOCUMENT CHANGE LOG

Change	Date	Affected Portions
	7/13/84	Original Version
A	1/20/92	Modifications to data formats
B	9/22/94	Change Dss numbers in Table 4-1

Table of Contents

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Tables

SECTION 1

1 GENERAL DESCRIPTION

1.1 Overview

This Software Interface Specification (SIS) describes the contents and format of the Supplementary Experiment Data Record (SEDR) and the formats of the tapes for transferring SEDR data to the ULS Principal Investigators (PIs).

1.2 Scope

Record and tape formats and data types will be covered in this document. There is only one SEDR format for the entire ULS mission. A separate tape format is created for each PI host computer.

1.3 Applicable Documents

ULS-MOS-3-700	ULS Mission Operations System Functional Requirements Document - Data Records System Functional Requirements
ULS-SDD-ANNEX1	ULS Flight Dynamics System Design and Specification Document
ICD ULS 3sbb	DPTRAJ SEDR Parameters (SIS)
ICD ULS 2sf	SCLK/SCET Coefficient File (SIS)
ULS-SRD-DRS-3	ULS SEDRGEN Software Requirements Document
ICD ULS 2tg	Generation and Delivery of SEDR Tapes

1.4 System Site

1.4.1 Subsystem Medium and Location

SEDR and SEDR tapes are generated on the UNISYS computer at the Information Processing Center (IPC) of the Jet Propulsion Laboratory (JPL).

1.4.2 Data Sources, Destinations, and Transfer Method

Data for the SEDR are derived from two sources: navigational parameters from the Navigational System DPTRAJ program and spacecraft spin axis orientation information from the ESOC Attitude History file. SEDR will be provided to PIs with an ongoing experiment aboard the ULS spacecraft. The transfer method for the SEDR will be by magnetic tapes.

ULS PIs may request a printout of all SEDR parameters for their own use at JPL during critical mission periods.

1.4.3 Generation Method and Frequency

The ULS Data Management Team (DMT) is responsible for the generation of SEDR. DMT will generate an SEDR file once a month containing data for the previous one-month period.

DMT will generate a set of Predict SEDR (PSEDR) that covers the entire ULS mission from launch to end-of-mission. DMT may generate additional predict SEDR on request from PIs. These may cover shorter periods than the nominal PSEDR, or may be generated using a more accurate trajectory, or both.

1.4.4 Labeling and Identification (Internal/External)

No internal magnetic tape labels exist on SEDR tapes. The SEDR records will have three SFDU headers which contain such information as project identifier, file identifier, and date and time of file generation.

An external tape number will be placed on the SEDR tape reel and strap. This tape number is comprised of the three letter designation of the experiment and the six digit SEDR identification code. The following coding scheme will be used:

1. XXX - three letter experiment designator.

2. 00 - two digit experiment number.

3. 0 - one digit mission phase code.

4. 0 - one digit SEDR type code.

5. 00 - two digit individual tape sequence number. This number increments from 01 to 99 for each experiment in each mission phase and for each SEDR type except remakes.

The following tables provide a detailed description of the breakdown of the SEDR tape number:

Table 1-1: Experiment Designator versus Number

Exp	Num	Comment
BAM	00	copy to JPL
GLG	01	copy to College Park
GRU	02	copy to Heidelberg
HED	03	copies to London and JPL
HUS	04	copies to Munich and Berkely
KEP	05	copies to Katlenburg-Lindow and El Segundo
LAN	06	copy to APL
SIM	07	copy to Chicago
STO	08	copies to Toulouse and GSFC
SCE	09	copy to Bonn
GWE	10	copy to Pavia
GLG	11	copy to Bern
SIM	17	copy to Kiel
DRS	20	(Data Records tape for file transfer - for JPL use only)

Table 1-2: Mission Phase Code

Code	Mission Phase
0	Pre-launch test data.
1	Injection to second TCM cruise.
2	Second TCM to third TCM cruise.
3	Third TCM to Jupiter cruise.
4	Jupiter encounter.
5	Post Jupiter phase.
6	High solar latitude phase. (High Southern solar lat.)
7	Post high latitude phase. (High Northern solar lat., Post mime mission phase)

Table 1-3: SEDR Type Code

Code	SEDR Type
0	Predict SEDR
1	Final SEDR (original)
2	Final SEDR remake #1
3	Final SEDR remake #2
4	Final SEDR remake #3
5	Final SEDR remake #4
6	Final SEDR remake #5
7	Final SEDR remake #6
8	Final SEDR remake #7
9	Final SEDR specially requested by a PI

The following is an example of a SEDR tape number:

Example: SIM 072103

Breakdown of the tape number "SIM 072103" is given as follows: This SEDR tape is designated for the Simpson experimenters (SIM) in Chicago (07). The SEDR data on the tape covers a portion of the cruise period between the second and third trajectory correction maneuvers or TCMs (2). The SEDR is the original "final" not a remake (1). Finally, this is the third in the series of SEDR tapes for the indicated mission phase (03).

1.5 Assumptions and constraints

1.5.1 Usage Constraints

The SEDR will be distributed in accordance with SIS 2tg on the generation and delivery os SEDR tapes.

1.5.2 Data Accuracy and Conventions

Data accuracy is defined in the ULS Mission Operations System Functional Requirements Document, Data Records System Functional Requirements (ULS-MOS-3-700).

Double precision (72 bits on the UNISYS) computation is used, but output to the SEDR is single precision (32 bits).

Fill data will be indicated by the value "1000". Note that the only possible fill data are the spin axis orientation data and the sun aspect angle during periods when the spacecraft is performing a maneuver.

DMT will inform PIs of any changes to the astronomical constants or conventions used on the SEDR. Viz., this SIS will continue to be maintained.

1.5.3 Time Tags

Each SEDR record is tagged with the time of the epoch for which the SEDR data are in effect. Both UTC and spacecraft clock count will be used in the time tagging. Time in UTC is equivalent to the spacecraft event time of the EDR. Spacecraft clock count will be computed from the spacecraft event time and will be consistent with the EDR.

The accuracy of the computed spacecraft clock count will be kept within $\pm$ 100 milliseconds of actual correlated relationships between spacecraft clock count and spacecraft event time. The smallest unit of computed spacecraft clock count is one one-thousandth of a count (2 milliseconds).

This requirement to maintain the required accuracy of the computed relationship between spacecraft event time and spacecraft clock count will account for the drift in spacecraft clock rate and any resets or rollovers of the spacecraft clock counter.

The SEDR does not provide any indication of spacecraft clock resets or rollovers. Such events will be noted in the logs and summaries which will accompany each shipment of SEDR.

SECTION 2

2 INTERFACE CHARACTERISTICS

2.1 Hardware Characteristics and Limitations

2.1.1 Special Equipment and Device Interfaces

None identified. SEDR tapes for the PIs will be in IBM compatible format.

2.1.2 Special Setup Requirements

None identified.

2.2 Volume and Size

The size of the SEDR file on tape will be less than 3000 tracks. A track contains 1792 32-bit words for the UNISYS computer. This is only an operational restriction set by DMT to ensure that an SEDR file will not require more than one reel of tape to write. Under the current plan of generating one SEDR file per month, the SEDR file should be less than 100 tracks per tape. DMT can adjust the size of the SEDR file by changing the processing time interval of the processing run.

2.3 Interface Medium Characteristics

SEDR records are comprised of 32-bit words. These words contain integer or floating point SEDR quantities depending upon the format requested. The SEDR file is written to a nine-track unlabelled tape at a density of 1600 bpi.

Logs and printed summaries on the start and stop times of the SEDR file and the number of records per tape are included in each SEDR shipment.

2.4 Failure Protection, Detection, and Recovery Procedures

2.4.1 File Backup Requirements

DMT will retain backup copies of the SEDR master files until end of mission plus three years, or until transfer of said data to a permanent archive center, whichever occurs earlier.

2.4.2 Security/Integrity Measures

DMT will restrict the release of SEDR to the ULS PIs. No other security measures are planned.

For data traceability, each SEDRGEN run will output an audit trail which identifies the source and version of the input data.

SECTION 3

3 ACCESS

3.1 Programs Using the Interface Data

PI software is not identified in this document. It will be the sole responsibility of the PI to produce software which accepts properly made SEDRs as its input.

3.2 Synchronization Considerations

3.2.1 Timing and Sequencing Characteristics

The records in the SEDR files will be in increasing Spacecraft Event Time (SCET) order (UTC).

3.2.2 Effective Duration

If the SEDR data are considered "final", the data will be within project science accuracy requirements for the time (UTC) indicated in each record.

SECTION 4

4 DETAILED INTERFACE SPECIFICATION

4.1 Overview of Structure and Organization

There will be only one file of SEDRs on each tape written for dissemination to the ULS PIs. (As a matter of consistency and predictability in operations, the DMT will limit the size of the SEDR file to that which will fit on a single reel of magnetic tape.) The SEDR file on tape shall terminate with two end-of-file tape markers. The layout of the SEDR file on tape is presented in Figure 4-1. There will be no internal tape labels on the SEDR tapes.

There will be two SEDR formats, integer or floating-point. Tertiary-SFDU-header word 24 of the first SEDR in the file shall identify which of the two formats shall be used for the remainder of the file. Details of this scheme are found in Sections 4.2.3 and 4.2.4 of this document.

First SEDR Record
IRG
Second SEDR Record
IRG
...
IRG
Last SEDR Record
EOF
EOF

Figure 4-1: SEDR Tape Layout

4.2 Substructure Definition and Format

The SEDR shall consist of three SFDU headers followed by a block of the supplementary experiment data (Figure 4-2). Each word in an SEDR shall be 32-bits in length. The first word in the SEDR shall be the first 32 bits of the primary SFDU header. All words in each SEDR shall be counted consecutively from this first word. Thus, since the three SFDU headers take up the first through the 25th word in the SEDR, the actual supplementary experiment data will appear in the 26th through the 288th words in the SEDR.

Primary SFDU Header
Secondary SFDU Header
Tertiary Header for SEDR
SEDR Data Block

Figure 4-2: Data Block

In the case of an integer format SEDR, an additional record, the scale factor block (Figure 4-3) will appear as the first record on the SEDR.

Primary SFDU Header
Secondary SFDU Header
Tertiary Header for SEDR
Scale Factor Block

Figure 4-3: Scale Factor Block

4.2.1 SFDU Headers

The format of the primary and secondary SFDU headers for the SEDR is presented in Figure 4-4 and is specified in detail in Table 4-1. The format of the tertiary SFDU header for the SEDR is presented in Figure 4-5 and is specified in Table 4-2.

4.2.2 SEDR Contents

The contents of the SEDR (i.e. what word represents which parameter) are presented in Table 4-3.

4.2.3 Details of the Integer-Format SEDR

If word 24 of the tertiary-SFDU-header of the *first* SEDR in the file is set to "1", all the *remaining* SEDRs in that file (and on that tape) will be in the *integer format.* In this case, the data words found in the first SEDR will contain the scale factors (powers of ten) by which the integer values found in the remaining SEDRs in the file will be multiplied to obtain their actual values. Word 24 of the tertiary-SFDU-header of the second, and all remaining integer-format SEDRs in the file will be set to "2" to indicate that the values found in each word of those SEDRs are integer values.

Although the scale factors mentioned above are found in the first record of every integer-format SEDR file, for the sake of completeness, they are listed below:

Parameter TypeScale Factors

Ranges, positions, counts	10^0	= 1
Degrees (LAT, LONG)	10^{-4}	= 1/10000
Velocities (except body-fixed ΔV)	10^{-6}	= 1/1000000
Body-fixed ΔV and Solar-rotation numbers	10^{-4}	= 1/10000

A negative value in integer-format SEDR shall be represented by its twos complement.

The integer-format shall be used for SEDRs produced for the following ULS Experiment Teams:

BAM, GLG (Bern), HED, and SIM (Germany)

4.2.4 Details of the Floating-Point-Format SEDR

If word 24 of the tertiary-SFDU-header of the *first* SEDR in the file is set to "0", *all* the SEDRs in that file (and on that tape), including the first SEDR, will be in the floating-point format. Furthermore, in this case, word 24 of the tertiary-SFDU-header of all the remaining SEDRs in the file will be set to "0".

The floating-point-words will appear as follows:

Bit Positions-

0	1 7	8 31
Sign	Characteristic	Fraction

where,

Sign will indicate the sign of the quantity represented by the floating-point word. If SIGN = 0, the quantity will be evaluated as positive; if SIGN = 1, the quantity will be evaluated as negative.

Characteristic allows the calculation of the value of the characteristic (or exponent) (base 16) of the floating-point word. The characteristic will be evaluated as $(CHAR_{16} - 40_{16})$

Fraction consists of the most significant digits of the mantissa of the floating-point quantity, which will be a hexadecimal fraction, the value of which will always lie between 0 and $(0.FFFFFFFFFFFFFFFFFFFFFFFF_{16})$.

Either of the following equations may be used to evaluate quantities in the floating-point format:

$$Value_{16} = (1 - 2*Sign_{16}) * (Fraction_{16}) * (10_{16})^\wedge(CHAR_{16} - 40_{16})$$

$$Value_{10} = (1 - 2*Sign_{10}) * (Fraction_{10}) * (16_{10})^\wedge(CHAR_{10} - 64_{10})$$

The following algorithm may be used to evaluate floating-point SEDR quantities:

1. Break-out the separate "raw" values of SIGN, CHAR, and FRACTION from the word.

2. Assume that the hexadecimal point of the number represented by FRACTION lies between bits 7 and 8 as FRACTION appears in the SEDR word.

3. Evaluate $N = CHAR_{16} - 40_{16}$

   a. If N = 0, the value of FRACTION as assumed in Step 2, above, is correct.

   b. If N < 0, shift the hexadecimal point in the assumed value of FRACTION to the left by N places, inserting N zeroes.

   c. If N > 0, shift the hexadecimal point in the assumed value of FRACTION to the right by N places, inserting N zeroes.

4. Finally, if SIGN = 0, the quantity is positive. If SIGN = 1, the quantity is negative.

The floating-point-format will be used for SEDRs produced for the following ULS Experiment Teams: GLG (U of Md), GRU, HUS, KEP, LAN, STO, SIM (Chicago), SCE, and GWE.

The SEDR made for archive by the DMT will be in floating point format.

WORD	Bits 0–15
1	Data Unit Specification (bits 0–7) | Start of Msg Pointer (bits 8–15)
	Control Authority | System Class | 2ndary Hdr ID
2	Message Data Unit Total Length
	Originator ID (bits 0–7) | Last Modifier ID (bits 8–15)
3	Major/Minor Data Class
3–4	Spacecraft Event Time
5	N/A
6	N/A
	N/A (bits 0–7) | N/A | Msg Status
7	Mission ID (bits 0–7) | Spacecraft ID (bits 8–15)
	N/A
8	Tertiary Header ID (bits 0–7) | Number of Data Groups (bits 8–15)
	N/A
9–10	Spacecraft Clock Time

Figure 4-4: ULS SEDR Primary and Secondary SFDU Headers

Table 4-1: ULS SEDR Primary and Secondary SFDU Header Definition

WORD	BITS	Description
1	0-3	Label Version Number - indicates the version of standard formatted data unit (SFDU) 0001 - Base Version Code (constant for ULS)
1	4-5	Character Set - indicates the character representation used within this record. 00 = binary type (constant for ULS)
1	6-7	Unit Structure Type - globally defines the gross structural characteristics of the data unit. 00 - (constant for ULS)
1	8-15	Start of Message Pointer - Number of bytes to beginning of message.
1	16-21	Control Authority - Institution controlling the contents of the remainder of the data unit. 000101 = NASA JPL (constant for ULS)
1	22-26	System Classification - Local system responsible for creating the secondary header. 00011 = Data Records System (DRS)
1	27-31	Secondary Header Identifier - Identifies the secondary header type. 00010 = ULS (constant for ULS)
2	0-15	Message Unit Classification - Total length of this record in bytes
2	16-23	Originator ID Data Records System = 42_{16}
2	24-31	Last Modifier ID Data Records System = 43_{16}

Table 4-1 (cont'd)

WORD	BITS	Description
3	0-15	Major/Minor Data Class Major Minor 5 - Experiment Data Record (EDR) 0 Spare 1 Gloeckler-Geiss Experiment (GLG) 2 Gruen Experiment (GRU) 3 Hedgecock Experiment (HED) 4 Hurley-Sommer Experiment (HUS) 5 Keppler Experiment (KEP) 6 Lanzerotti Experiment (LAN) 7 Simpson Experiment (SIM) 8 Stone Experiment (STO) 9 Engineering Data (enge) A Bame Ion Experiment B Bame Electron Experiment C Engineering Data (engs) D 0 Monitor 5-9 Records
3 4	16-31 0-15	Spacecraft Event Time (SCET) - Time of the first minor frame from which this record's prime data was extracted, elapsed seconds since Jan 1, 1950 (UTC).
4	16-31	Fraction of a second of SCET, binary point assumed to the left of bit 16.
5	0-31	Earth Received Time (ERT) - Time of Earth receipt of the first minor frame from which this record's prime data was extracted, elapsed seconds since Jan 1, 1950 (UTC).
6	0-15	Fraction of a second of ERT, binary point assumed to the left of bit 0.

Table 4-1 (cont'd)

WORD	BITS	Description
6	16-23	User Dependent Type (UDT) code: 0B = DTM 1, Channel 1 07 = DTM 1, Channel 2 73 = DTM 2, Channel 1 08 = DTM 2, Channel 2 0C = DTM 3, Channel 1 09 = DTM 3, Channel 2 0D = DTM 4, Channel 1 0A = DTM 4, Channel 2 01 = DTM 5, Channel 1 02 = DTM 5, Channel 2 26 = DTM 6, Channel 1 27 = DTM 6, Channel 2
		Mission Mode Flags - Indicators for how data was generated for this record.
6	24	Spacecraft Realtime/Playback Data Flag - Indicates whether data was downlinked by the spacecraft in realtime or as a result of a tape recorder playback. 0 = Realtime data or not applicable 1 = Playback data
6	25	Real/Simulated Data Flag - Indicates whether data is real or stimulated. 0 = Real data 1 = Simulated data
6	26	System Test/MOS Flag - Indicates whether data is test or flight generated. 0 = Test complex generated 1 = Flight (MOS) generated
6	27	Replay Flag - Indicates if record contains replay data. 0 = Initial acquisition or not applicable 1 = Replay data
		Message Contents Quality Status - Indicates gross quality of the data in the secondary and tertiary headers and/or in the data block.

Table 4-1 (cont'd)

WORD	BITS	Description
6	28	Data Quality Flag - Indicates if the data portion of this record is valid or not. 0 = data valid 1 = data suspect, incomplete or invalid
6	29	Spacecraft Clock Flag - Indicates if the spacecraft clock is valid or not. 0 = SCLK is valid 1 = SCLK is missing, incomplete or invalid
6	30	Spacecraft Event Time Flag - Indicates if the SCET value is valid or not. 0 = SCET is valid 1 = SCET is missing, incomplete or invalid
6	31	Earth Received Time Flag - Indicates if the ERT value is valid or not. 0 = ERT is valid 1 = ERT is bad or missing
7	0-7	Mission ID 03_{16} = Ulysses
7	8-15	ULS Spacecraft ID = 37_{16} (55_{10}) (Flight Spacecraft) 41_{16} (65_{10}) (Simulation/Test)

Table 4-1 (cont'd)

WORD	BITS	Description
7	16-23	DSN Source Station - Indicates the DSN source station. (Controlled by document 820-13, module OPS-6-21). Permitted Value — Interpretation Hex / Dec 55 / 85 — DSS 05 (34-m STD, CTA-21) 5B / 91 — DSS 06 (70-m, CTA-21) 5F / 95 — DSS 07 (34-m HEF, CTA-21) BD / 189 — DSS 09 (34-m BWG, JPL Test Facility) 81 / 129 — DSS 12 (34-m STD, Goldstone) 82 / 130 — DSS 14 (70-m, Goldstone) 83 / 131 — DSS 15 (34-m HEF, Goldstone) C9 / 201 — DSS 24 (34-m BWG, Goldstone, Subnet 1) CA / 202 — DSS 25 (34-m BWG, Goldstone, Subnet 2) CB / 203 — DSS 26 (34-m BWG, Goldstone, Subnet 3) E6 / 230 — DSS 27 (34-m BWG, Goldstone, Subnet 1) E7 / 231 — DSS 28 (34-m BWG, Goldstone, Subnet 2) 9A / 154 — DSS 34 (34-m BWG, Tidbinbilla) 92 / 146 — DSS 42 (34-m STD, Tidbinbilla) 93 / 147 — DSS 43 (70-m, Tidbinbilla) 94 / 148 — DSS 45 (34-m HEF, Tidbinbilla) F3 / 243 — DSS 61 (34-m STC, Robledo) F4 / 244 — DSS 63 (70-m, Robledo) FD / 253 — DSS 65 (34-m HEF, Robledo)
7	24-31	Format - Indicates the interleave ratio Code Description 0 non-interleaved 1 unknown interleave ratio 2 1:1 ratio 3 3:1 ratio 4 7:1 ratio
8	0-7	Tertiary Header ID - indicates the type of tertiary header that follows the secondary header - 03_{16} = Data Records System header
8	8-15	Number of Data Groups = 1
8	16-31	Unused (0 fill)
9	0-31	Spacecraft Clock Count (whole number counts with an implied binary point at the right).

Table 4-1 (cont'd)

WORD	BITS	Description
10	0-15	Spacecraft Clock Count (fractional part of count with an implied binary point at the left).

WORD	0 2 4 6 8 10 12 14	16 18 20 22 24 26 28 30
10	Part of Secondary Hdr	Spare Bits for Padding
11	SEDR Identification	
12		
13	SEDR Record Generation Date	
14	SEDR Record Generation Time	
15	Spare Bits for Padding (zeroes)	
16		
17	Attitude History File Generation Date	
18	Attitude History File Generation Time	
19	Start Time of Validity for Attitude History Record	
20		
21	Stop Time of Validity for Attitude History Record	
22		
23	Attitude History Record Status Indicators	
24	SEDR Record Identifier	
25	Spare Word (zeroes)	

Figure 4-5: ULS SEDR Tertiary SFDU Header

Table 4-2: ULS SEDR Tertiary SFDU Header Definition

Word	Bits	Description
10	16-31	Spare bits for padding (zeroes)
11	0-31	Spare word (zeroes)
12	0-31	Last four digits of the SEDR Identification Number, integer format: MSTT where- M is the mission phase code S is the SEDR type code T identifies the tape sequence number (see section 1.4.4)
13	0-31	SEDR Record Generation Date, integer format: YYDDD (year, DOY) (e.g. 91300_{10})
14	0-31	SEDR Record Generation Time, integer format: HHMMSS (e.g. 210756_{10})
15 16	0-31	Spare words (zeroes)
17	0-31	Attitude History File Generation Date, integer format: YYDDD
18	0-31	Attitude History File Generation Time, integer format: HHMMSS
19	0-31	Start Date of Validity of Attitude Record, integer format: YYDDD
20	0-31	Start Time of Validity of Attitude Record, integer format: HHMMSS
21	0-31	Stop Date of Validity of Attitude Record, integer format: YYDDD
22	0-31	Stop Time of Validity of Attitude Record, integer format: HHMMSS

Table 4-2 (cont'd)

Word	Bits	Description
23	0-31	Attitude Record Status Indicators from Attitude History File, 3 digit decimal integer format XYZ, where X = 0 Actual Attitude History Data X = 1 Predict Attitude History Data Y = 0 delta-v accurate Y = 1 delta-v inaccurate Z = 0 delta-v provided Z = 1 delta-v not provided
24	0-31	SEDR Record Identifier, integer where 0 - floating point record 1 - scale factor record 2 - integer record (see sections 4.2.3 and 4.2.4)
25	0-31	Spare Word (zeroes)

Table 4-3: ULS SEDR Data Format

SEDR Word	Description	Units
26-27	Right Ascension and Declination of S/C Spin Axis, S/C Centered, Earth Mean Equator and Equinox of 1950.0	deg
28-29	Celestial Latitude and Longitude of S/C Spin Axis, S/C Centered, Earth Mean Ecliptic and Equinox of 1950.0	deg
30	Spare Word (zeroes)	
31-36	Cartesian State of S/C, Earth Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
37-42	Cartesian State of S/C, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
43-48	Cartesian State of S/C, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
49-54	Cartesian State of S/C, Io Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
55-60	Cartesian State of S/C, Europa Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
61-66	Cartesian State of S/C, Ganymede Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
67-72	Cartesian State of S/C, Callisto Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
73-78	Cartesian State of Earth, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
79-84	Cartesian State of Jupiter, Sun Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
85-90	Cartesian State of Earth, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
91-96	Cartesian State of Io, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
97-102	Cartesian State of Europa, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
103-108	Cartesian State of Ganymede, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec
109-114	Cartesian State of Callisto, Jupiter Centered, Earth Mean Ecliptic and Equinox of 1950.0	km km/sec

Table 4-3 (cont'd)

SEDR Word	Description	Units
115-120	Cartesian State of S/C, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
121-126	Cartesian State of Io, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
127-132	Cartesian State of Europa, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
133-138	Cartesian State of Ganymede, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
139-144	Cartesian State of Callisto, Jupiter Centered, Jupiter True Orbit and Prime Meridian in Sun Direction	km km/sec
145-150	Cartesian State of S/C, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date	km km/sec
151-153	Cartesian Position of Io, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date	km
154-156	Cartesian Position of Europa, Jupiter Centered, Jupiter System True Prime Meridian and Equator of Date	km
157-159	Cartesian Position of Ganymede, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date	km
160-162	Cartesian Position of Callisto, Jupiter Centered, Jupiter System I True Prime Meridian and Equator of Date	km
163-168	Cartesian State of S/C, Jupiter Centered, Jupiter System III (1965.0) True Prime Meridian and Equator of Date	km km/sec
169-171	Cartesian Position of Io, Jupiter Centered, Jupiter System III (1965.0) True Prime Meridian and Equator of Date	km
172-174	Cartesian Position of Europa, Jupiter Centered, Jupiter System III True Prime Meridian and Equator of Date	km
175-177	Cartesian Position of Ganymede, Jupiter Centered, Jupiter System III (1965.0) True Prime Meridian and Equator of Date	km
178-180	Cartesian Position of Callisto, Jupiter Centered, Jupiter System III (1965.0) True Prime Meridian and Equator of Date	km
181-183	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of S/C	deg
184-186	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of Io	deg

Table 4-3 (cont'd)

SEDR Word	Description	Units
187-189	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of Europa	deg
190-192	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of Ganymede	deg
193-195	Jupiter Planetocentric Latitude, System I Longitude and System III (1965.0) Longitude of Callisto	deg
196	Range Earth - S/C	km
197	Range Sun - S/C	km
198	Range Sun - Earth	km
199	Range Sun - Jupiter	km
200	Range Jupiter - S/C	km
201	Range Jupiter - Io	km
202	Range Jupiter - Europa	km
203	Range Jupiter - Ganymede	km
204	Range Jupiter - Callisto	km
205	Angle Earth - Sun - S/C	deg
206	Angle Sun - S/C - Earth (Celestial Cone Angle of Earth)	deg
207	Angle Sun - Earth -S/C	deg
208	Angle Jupiter - Sun - S/C	deg
209	Angle Sun - S/C - Jupiter (Celestial Cone Angle of Jupiter)	deg
210	Angle Sun - Jupiter - S/C	deg
211	Angle Earth - S/C - Jupiter	deg
212	Angle Sun Aspect (Angle Between Spacecraft Spin Axis and Direction to Sun)	deg
213-214	Right Ascension and Declination of S/C, Earth Centered, Earth Mean Equator and Equinox of 1950.0	deg
215-216	Right Ascension and Declination of Sun, Earth Centered, Earth Mean Equator and Equinox of 1950.0	deg
217-218	Right Ascension and Declination of Jupiter, Earth Centered, Earth Mean Equator and Equinox of 1950.0	deg

Table 4-3 (cont'd)

SEDR Word	Description	Units
219-220	Right Ascension and Declination of S/C, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
221-222	Right Ascension and Declination of Sun, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
223-224	Right Ascension and Declination of Io, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
225-226	Right Ascension and Declination of Europa, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
227-228	Right Ascension and Declination of Ganymede, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
229-230	Right Ascension and Declination of Callisto, Jupiter Centered, Jupiter True Equinox and Equator of Date	deg
231-232	Celestial Latitude and Longitude of S/C, Sun Centered, Earth True Equinox and Ecliptic of Date	deg
233-234	Celestial Latitude and Longitude of Earth, Sun Centered, Earth True Equinox and Ecliptic of Date	deg
235-236	Celestial Latitude and Longitude of Jupiter, Sun Centered, Earth True Equinox and Ecliptic of Date	deg
237-238	Right Ascension and Declination of S/C, Sun Centered, Sun True Equinox and Equator of Date	deg
239-240	Right Ascension and Declination of Earth, Sun Centered, Sun True Equinox and Equator of Date	deg
241-242	Right Ascension and Declination of Jupiter, Sun Centered, Sun True Equinox and Equator of Date	deg
243-244	Heliographic Latitude and Longitude of S/C	deg
245-246	Heliographic Latitude and Longitude of Earth	deg
247-248	Heliographic Latitude and Longitude of Jupiter	deg
249-254	Cartesian State of S/C, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date	km km/sec
255-260	Cartesian State of Io, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date	km km/sec
261	Range Jupiter Magnetic Dipole - S/C	km

Table 4-3 (cont'd)

SEDR Word	Description	Units
262-263	Latitude and Longitude of S/C, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date	deg
264-265	Latitude and Longitude of Io, Jupiter Magnetic Dipole Centered, Jupiter Magnetic Meridian and Equator of Date	deg
266	Solar Rotation Number Relative to Earth	rotations
267	Solar Rotation Number Relative to Spacecraft	rotations
268-273	Cartesian State of Saturn, Sun centered, Earth Mean Ecliptic and Equinox of 1950	km km/sec
274-288	Spare Words (zeroes)	

APPENDIX A Glossary

Cartesian State	Cartesian position and velocity components in the following order: x-position, y-position, z-position, x-velocity, y-velocity, and z-velocity.
Equinox	Vernal equinox. For the planets, the vernal equinox is defined as the axis from the center of the planet to the ascending node of the planet's orbit through the planet's equatorial plane.
Jupiter System I	This prime meridian system is identified with the Prime Meridian rotation of the visible features in the Jovian equatorial zone. The exact definition of this system can be found in the Explanatory Supplement to the Astronomical Ephemeris and The American Ephemeris and Nautical Almanac (Explanatory Supplement to the Ephemeris). JPL Technical Report (TR) 32-12508, dated January 15, 1971.
Jupiter System III	This prime meridian system is identified with the Prime Meridian rotation of radio emissions from Jupiter. This rotation probably corresponds to the rotation of the Jovian inner core which is associated with the planet's magnetic field. The SEDR uses Jupiter System III (1965.0).
Longitude	The longitude convention will conform to the IAU standards which specify positive west longitudes for Jupiter.

APPENDIX B List of Acronyms and Abbreviations

BPI	Bits per inch
CDFGEN	Common Data File Generation (program)
deg	Degrees
DEC	Declination
DMT	Data Management Team
DOY	Day of Year
DPTRAJ	Double Precision Trajectory program
DRS	Data Records System
DUT	Difference between ET and UTC times (55.2 for 1 July 1985)
E	Floating Point Quantity
ECL50	Earth Mean Ecliptic and Equinox of 1950.0
EME50	Earth Mean Equator and Equinox of 1950.0
ERT	Earth Received Time
ESOC	European Space Operations Centre
ET	Ephemeris Time
HHMMSS	Hours-Minutes-Seconds
HEX	Hexadecimal Number
I	Integer Quantity
IAU	International Astronomical Union

ID	Identification
IPC	Information Processing Center
IRG	Inter-record Gap
JPL	Jet Propulsion Laboratory
km	Kilometers
km/sec	Kilometers Per Second
N/A	Not Applicable or Not Available
NAV	Navigation System or Team
P-FILE	Probe Ephemeris File
PI	Principal Investigator
RA	Right Ascension
S/C	Spacecraft
SCET	Spacecraft Event Time
SCLK	Spacecraft Clock (count)
SEDR	Supplementary Experiment Data Records
SEDRGEN	Supplementary Experiment Data Records Generation (program)
SFDU	Standard Formatted Data Unit (headers)
SIS	Software Interface Specification
SRD	Software Requirements Document
TBD	To Be Determined
TBS	To Be Supplied

TCM	Trajectory Correction Maneuver
UTC	coordinated Universal Time
YYDDD	Year (last two digits) - day of year

90-090B-05A
Solar Wind Plasma Ions

ULYSSES

SOLAR WIND PLASMA IONS

90-090B-05A

THIS DATA SET CONSISTS OF 1 MAGNETIC TAPE. THE TRACK IS 9-TRACK, 6250 BPI, CREATED ON A VAX COMPUTER, WRITTEN IN ASCII, WITH A LABEL OF NAME OF "ULYION". A DIRECTORY OF THE TAPE, AS WELL AS COPIES OF THE TEXT FILES WHICH INCLUDES A USER'S GUIDE AND ERRATA TO THE GUIDE HAVE BEEN INCLUDED. THE D AND C NUMBER ALONG WITH IT'S TIMESPAN IS LISTED BELOW.

D#	C#	FILES	TIMESPAN
D-107970	C-031714	32	11/18/90-04/02/95

DATA WAS DOWNLOADED AND COPIED FROM ANON_DIR:[COHO.ULYPLA.ION]ACCOUNT

Directory D-107970

```
COHO_ULYPLA_ION.LIS;3                           HOURAV_90.DAT;1     HOURAV_91.DAT;1
HOURAV_92.DAT;1      HOURAV_93.DAT;1            HOURAV_94.DAT;2     HOURAV_95.DAT;2
HOURAV.DAT;2         SWI9101.ASC;1              SWI9408.ASC;1       SWI9503.ASC;1
SWOOPS_ION_ERRATA_V02.DOC;1                     SWOOPS_ION_USERS_GUIDE_V02.DOC;1
U90322BAM.DAT;3      U91001BAM.DAT;1            U91092BAM.DAT;3     U91183BAM.DAT;3
U91274BAM.DAT;3      U92001BAM.DAT;3            U92092BAM.DAT;3     U92183BAM.DAT;3
U92274BAM.DAT;3      U93001BAM.DAT;3            U93092BAM.DAT;3     U93183BAM.DAT;3
U93274BAM.DAT;3      U94001BAM.DAT;2            U94092BAM.DAT;5     U94183BAM.DAT;1
U94274BAM.DAT;1      U95001BAM.DAT;1            U95092BAM.DAT;1
```

Total of 32 files.

NSSDC USER'S GUIDE FOR DATA FROM THE ULYSSES SWOOPS PLASMA EXPERIMENT: THE POSITIVE ION EXPERIMENT

TABLE OF CONTENTS

1. OVERVIEW OF THE SWOOPS EXPERIMENT

The SWOOPS (Solar Wind Observations Over the Poles of the Sun) experiment has two electrostatic analyzers, one for positive ions and one for electrons. The instrument is fully described in: The Ulysses Solar Wind Plasma Experiment, S. J. Bame, D. J. McComas, B. L. Barraclough, J. L. Phillips, K. J. Sofaly, J. C. Chavez, B. E. Goldstein, and R. K. Sakurai, Astronomy and Astrophysics Supplement Series, Ulysses Instruments Special Issue, Vol. 92, No. 2, p. 237-265, 1992. The electron and ion analyzers are separate experiments that operate asynchronously. For this reason, the data from the experiments are submitted separately to the NSSDC. This document describes the positive ion analyzer and the data submitted to the NSSDC for that analyzer; the electron experiment is described in a comparable document that accompanies the electron data. The experiment was designed as a solar wind investigation, and the results from the positive ion part of the experiment at Jupiter were generally not useful because of field of view problems; Jovian magneosheath and magnetosphere data (1992 033 17:00 to 1992 048 02:00) are therefore not submitted to the NSSDC.

2. INTRODUCTION TO THE SWOOPS ION EXPERIMENT

The SWOOPS ion analyzer measures 3-d velocity space distributions of positively-charged ions. In its normal solar wind mode, the instrumental energy range is 0.25 to 12 keV/Q; active energy tracking allows for fine energy spacing within a smaller range which is ample for characterization of the thermal proton and helium distributions in most cases. The analyzer does not make an explicit ion species determination; separation of protons from doubly-charged helium is enabled by the fact that the two species have similar convection speeds. During periods of spacecraft nutation only the bulk speed and density are reliable, individual velocity components and temperatures are invalid. The beginning of scientifically useful SWOOPS data is at Day 322, 00:59 of 1990; at that time the spacecraft was already nutating; nutation ceased as of Day 351, 22:00, 1990. As Ulysses approaches the Sun, nutation may resume during periods when active attitude control is not available (active attitude control requires a continuous uplink).

3A. INSTRUMENT OPERATION-SUMMARY

Each spectrum takes 2 minutes to accumulate, but telemetry takes longer. A spectrum is telemetered to the ground in 4 minutes at highest bit rate, at lower spacecraft bit rates the time is greater. Depending on the mission phase, the data may all be high time resolution, may be partially high time resolution (some 4 minute sampled data, and some 8 minutes sampled data), or may be sampled at rates even slower during certain occasions. Depending on the bit rate, every 5th (highest bit rate) or 9th spectrum (all slower bit rates) is obtained with half the energy resolution of the other spectra.

3B. INSTRUMENT OPERATION-DETAILED DESCRIPTION

The positive ion analyzer is provided with a 200-level high voltage supply to cover a range of ion energies from 255 eV/q to 34.4 keV/q. Level spacings are 2.5%, and are used in a variety of ways.

The normal SWOOPS mode of operation consists of three types of modes, two that deal with protons and alpha particles, and one (not described here) that deals with heavy ions. The two types of measurement modes used for measuring protons and alpha particles are the Search (S) mode and T (track) mode. The instrument first does a coarse energy scan (S mode) consisting of 40 steps (every 4th step in the lowest 160 of the instrument's 200 available levels). Having located the solar wind flux peak, the instrument then does several T scans in the region around the peak using every other energy step. To obtain increased energy resolution during periods when the solar wind is not changing speed, the instrument was designed so that T scans alternate using the even- and odd-numbered steps of the voltage supply. The data provided to the NSSDC are based upon individual scans; the alternating even (E) and odd (O) scans have not been combined. During the highest bit rate operation one S scan is followed by eight T scans, at all other data rates one S scan is followed by four T scans. Differences between estimates of solar wind parameters based on lower energy resolution data (S mode) and neighboring T mode data are at times noticeable in plots as S mode outliers in the velocity and temperature values. Generally speaking, the alternating types (O and E) of T mode do not lead to apparent effects in the reduced parameters. However, during exceptionally cold periods, such as within a Coronal Mass Ejection at distances significantly beyond the orbit of the Earth, upon rare occasions an O/E mode alternation in the density and direction of flow is apparent in the reduced data.

SWOOPS heavy ion data are not submitted to the NSSDC because the instrument does not have a mass separation capability or coincidence detection for noise suppression. Data from the SWICS experiment are better suited for heavy ion investigations.

4. DATA REDUCTION ALGORITHMS

Plasma parameters are calculated by numerical integration of velocity-weighted ion distributions over an E/q range chosen to include the thermal proton and alpha-particle populations. Under extremely hot conditions, there can sometimes be some overlap between these populations. Additionally, during periods when the solar wind temperature is exceptionally low the experiment can not properly measure the temperature. Care has been taken to estimate the instrument background from channels that do not contain data, and the effects of background have been removed from the integration. The velocity space resolution of the experiment is better in the energy dimension than in the angular dimensions.

The proton temperature has been estimated in two different ways, one of which will sometimes lead to an overestimate of the temperature and one of which will sometimes lead to an underestimate. T-large is the integral of the distribution in three-dimensional velocity space over all energy channels and angle bins that are statistically above noise. The criterion for noise determination is based upon the estimation of the total contribution from a shell that is spherically symmetric in velocity space. T-large has the drawback that at times when the solar wind is cold the angular responses of the instrument channels are as wide or wider than the beam, and the temperature is overestimated. T-small is estimated by summing over angle the observations at a fixed energy. The moments of the resulting one dimensional plasma spectrum are then summed and the resulting RR (radial) component of the temperature tensor is used as the estimate of proton temperature. Additionally, to avoid contamination from alpha particles, no channels further in velocity space from the proton peak than the minimum in flux between the proton and alpha particles peaks are used in the T-small estimate. T-large and T-small will generally bracket the true temperature. However, for very cold plasma, T-small may not be a true minimum.

In the analyses already described, when performing the numerical integration over velocity space it is assumed that the instrument response within a given channel is uniform and that the viewing area of the channel is uniformly filled with plasma. A least squares fitting procedure to a bi-Maxwellian distribution that includes the instrument reponse is currently (November, 1996) under development, it will be able to improve estimates under difficult conditions (very cold plasma). However, this procedure can not be used for routine data reduction because of computer time requirements. Persons desiring specialized analyses of particular time periods should request the needed data directly from the SWOOPS team (see section 6 below).

In addition to the issues of temperature determination already discussed, there are also small systematic uncertainties in the velocity components. These are due to such effects as uncertainty in the accuracy of alignment on the spacecraft, variation in gains between channeltrons, etc. The velocity component data should not be used for studies of large scale, long term, solar wind deflection. The data are generally suitable for all other studies. The data have been corrected for spacecraft velocity.

The Odd and Even mode scans start at odd or even energy steps of the instrument, and during a scan the energy channel is increased by two steps for each observation. To improve the temperature resolution of the experiment we have also produced combined parameters from adjacent Odd and Even scans. If the peak shifts to that the peak of adjacent Odd and Even spectra are not contiguous in the scan, then a combined spectra is not produced. Since there are sometimes considerably less data in the combined than in the O/E mode, the high resolution data provided to the NSSDC are the O/E mode. The hourly averages are based upon the combined spectra. Users are CAUTIONED that the hourly averages are based on combined mode (higher energy resolution spectra) will typically provide temperature estimates a bit lower (depends on distance from the Sun) than hourly averages of the O/E mode high resolution spectra.

Spacecraft velocities are removed from all Ulysses data; i.e., velocities are defined with respect to the Sun.

5. DESCRIPTION AND FORMAT OF DATA SUBMITTED TO THE NSSDC

The data provided to the NSSDC are the fluid (mass averaged proton and alpha particles) velocity components, proton number density, alpha particle number density, and an upper and lower limit on proton temperature. Two types of data are provided: high resolution data and hourly averages.

Definition of Solar Heliospheric RTN coordinates:

R is a unit vector pointing from the Sun to the spacecraft. T is Omega x R, where Omega is a unit vector along the Sun's rotation axis. N = R x T.

5.A FORMAT OF HIGH RESOLUTION DATA

The time specified in the file is 3.5 spins after the beginning of the acquisition of a spectrum. For T mode data, the peak of the proton flux is typically found at energies sampled during spins 3 and 4. For S mode data the time at which the peak is observed is variable and depends on the solar wind speed, hence the time in the file does not precisely reflect the time the observation is made.

```
      open (3, file='SwoopsIon', status='old', readonly,
     + carriagecontrol='list')

c       iyr            - year
c       idoy           - day of year (Jan 1 = 001)
c       ihr            - hour
c       imin           - minute
c       isec           - second
c       rau            - sun-spacecraft distance, AU
c       hlat           - heliosperic latitude
c       hlong          - heliospheric longitude
c                        (Carrington longitude of spacecraft)
c       densp          - proton number density per cubic centimeter
c       densa          - alpha number density per cubic centimeter
c       tlarge         - proton temperature, Kelvin
c       tsmall         - proton temperature, Kelvin
c       vr, vt, vn     - plasma velocity (km/sec) in heliospheric
c                        RTN coordinates in the solar system frame
c       qual           - condition flags

        read (3, 1) iyr, idoy, ihr, imin, isec,
     + rau, hlat, hlong, densp, densa, tlarge, tsmall, vr, vt, vn, qual

1       format (1X,I2,1X,I3,3(1X,I2),F7.4,2F7.2,
     + 2(1X,F10.5),1X,2F10.0,3(1X,F7.1),1X,I4)
```

The variable qual is set to 0 for "good" data. "Good" means that there was nothing detectable wrong with the data except that in some cases the temperature is so high that the proton observations overlap the alpha particle observations. If qual=1, there is something questionable about the data. Bit errors that have automatically been corrected by the program, anomalies in the data that are sometimes detected by the program when the data are too cold for proper reduction, spectra for which some missing data have been zero filled, etc., all have qual=1. Spectra for which the alpha particle portion of the analysis failed are not included in the data submitted to the NSSDC. In general, users should restrict the use of data to qual=0. However, data that are bad can often be ascertained by inspection when plotted in a time series, so that for studies of individual events the qual=1 data can also be useful.

5.B FORMAT OF HOURLY AVERAGE DATA

The hourly average data are computed from the high resolution data excluding points for which qual=1. The format of the hourly data is identical to that of the high resolution data except that the qual word is not written to the file.

```
        read (3, 9) iyr, idoy, ihr, imin, isec,
     + rau, hlat, hlong, densp, densa, tlarge, tsmall, vr, vt, vn
```

```
9       format (1X,I2,1X,I3,3(1X,I2),F7.4,2F7.2,
     + 2(1X,F10.5),1X,2F10.0,3(1X,F7.1))
```

The time intervals for an hourly average are from the beginning to the end of an hour, e.g., from 01:00 to 02:00, with the time in the data record being at the center of the interval, e.g., 93 125 01 30 00.

6. PERIODS OF BAD ATTITUDE OR SUN SENSOR PROBLEMS

During certain periods the spacecraft was undergoing reorientation, or the sun sensors on the spacecraft were being switched and the spacecraft orientation was unknown. For such data, only the speed and temperatures are reliable; the velocity components are unreliable. A list (not claimed to be complete) of times during which such problems are present is:

```
90 348 1800 90 349 0300 SUNSP   SUN SENSOR PROBLEM
90 353 1500 90 353 1800 SUNSP   (FOLLOWED BY DATA GAP UNTIL 354 0230)
91 030 0000 91  30 0900 SUNSP   SUN SENSOR PROBLEM
93 319 1100 93 319 1957 BADAT   SPACECRAFT ATTITUDE MANUEVER
94 052 1155 94 052 1700 BADAT   SPACECRAFT ATTITUDE MANUEVER
```

7. FURTHER INFORMATION

For information on acquiring other types of data not provided to the the NSSDC, contact the Principal Investigator, Dr. David J. McComas, at the Los Alamos National Laboratory, dmccomas@lanl.gov, 505-667-0138. For information on the reduction and analysis of data from the positive ion and electron experiments, contact Dr. Bruce E. Goldstein at the Jet Propulsion Laboratory, bgoldstein@jplsp2.jpl.nasa.gov, 818-354-7366.

Errata to Version 01 & 02 of SWOOPS Ion User's Guide

02/03/95: All document and data files with date versions through this date are either those orginally supplied by the SWOOPS team or more recently updated as of this date. Files affected by revisions included the hourly data file and the high resolution data file for 93/274 - 93/365; only the files dated 2/3/95 or later for these data should be used.

06/18/95: As of this date the SWOOPS ion data, including high resolution and hourly average data files, were completely updated from launch through first quarter 1994 after reprocessing by the P.I. team. SWOOPS ion data files created earlier than this date should be discarded. Version 01 of the user's guide is still in effect.

12/16/96, message from Bruce Goldstein, JPL:
The SWOOPS ion documentation for data submitted to the NSSDC has been updated to correct an error and to warn users about differences between the data used for hourly averages and high resolution temperature estimates. (The documentation said that there were more combined mode spectra than O/E mode spectra, this is the reverse of reality; it would not have any effect on anything a user did but was provided to explain why we did some averaging in a certain fashion). There is also a warning added that since the hourly averages of temperatures are based upon combined data they will be somewhat lower than an average that a user might compute himself based on the O/E mode data.

These are just informational points and do not represent any sort of errata or correction to the data. The new document file at NSSDC is named SWOOPS_ION_USERS_GUIDE_V02.DOC. No changes have been made to the data files in the NSSDC data set.

J. F. Cooper
Ulysses Acquisition Scientist
National Space Science Data Center

90-090B-05B
Solar Wind Plasma Electrons

ULYSSES

SOLAR WIND PLASMA ELECTRONS

90-090B-05B

THIS DATASET CONSISTS OF 1 MAGNETIC TAPE. THE TAPE IS 9-TRACK 6250-BPI,CREATED ON A VAX COMPUTER WITH A LABEL NAME OF "ULYELE". A DIRECTORY OF THE TAPE, AS WELL AS A COPY OF THE USERS GUIDE WHICH CONTAIN THE FORMAT FOR THE TAPE HAVE BEEN INCLUDED IN THE CATALOG. THE D AND C NUMBER ALONG WITH IT'S TIME SPAN IS LISTED BELOW.

D#	C#	FILES	TIMESPANS
D-107971	C-031715	21	11/18/90-07/02/95

** DATA WAS DOWNLOADED AND COPIED FROM ANON_DIR:[COHO.ULYPLA.ELECTRON]**

Directory D-107971

```
SWOOPS_ELECTRON_USERS_GUIDE_V01.DOC;1    SWOOPS_ELE_ERRATA_V01.DOC;1
U90322BAMELE.DAT;6  U91001BAMELE.DAT;2  U91092BAMELE.DAT;1  U91183BAMELE.DAT;1
U91274BAMELE.DAT;2  U92001BAMELE.DAT;1  U92092BAMELE.DAT;1  U92183BAMELE.DAT;1
U92274BAMELE.DAT;3  U93001BAMELE.DAT;1  U93092BAMELE.DAT;1  U93183BAMELE.DAT;1
U93274BAMELE.DAT;1  U94001BAMELE.DAT;1  U94092BAMELE.DAT;1  U94183BAMELE.DAT;1
U94274BAMELE.DAT;1  U95001BAMELE.DAT;1  U95092BAMELE.DAT;1
```

Total of 21 files.

NSSDC USER'S GUIDE FOR DATA FROM THE ULYSSES SWOOPS PLASMA EXPERIMENT: THE ELECTRON EXPERIMENT

TABLE OF CONTENTS

1. OVERVIEW OF THE SWOOPS EXPERIMENT

The SWOOPS (Solar Wind Observations Over the Poles of the Sun) experiment has two electrostatic analyzers, one for positive ions and one for electrons. The instrument is fully described in: The Ulysses Solar Wind Plasma Experiment, S. J. Bame, D. J. McComas, B. L. Barraclough, J. L. Phillips, K. J. Sofaly, J. C. Chavez, B. E. Goldstein, and R. K. Sakurai, Astronomy and Astrophysics Supplement Series, Ulysses Instruments Special Issue, Vol. 92, No. 2, p. 237-265, 1992. The electron and ion analyzers are separate instruments that operate asynchronously. For this reason, the data from the two sensors are submitted separately to the NSSDC. This document describes the electron analyzer and the data submitted to the NSSDC for that analyzer; the ion experiment is described in a comparable document that accompanies the ion data.

2. INTRODUCTION TO THE SWOOPS ELECTRON EXPERIMENT

The SWOOPS electron spectrometer is a 120-degree spherical section electrostatic analyzer which measures the 3-d velocity space distributions of solar wind electrons. In its normal solar wind mode, the instrumental energy range is 1.6 to 862 eV in the spacecraft frame. Since the spacecraft generally charges to +2 to +15 volts, 2 to 15 eV is subtracted from the measured energies (electrons measured at energies below the spacecraft potential are electro-statically trapped photoelectrons). The beginning of scientifically useful SWOOPS data is at the beginning of Day 322 of 1990.

The electron instrument is subject to a "sleep mode" triggered by changes in the spacecraft configuration. The first time this mode occurred it caused a long gap in the electron (but not the ion) data: from 0621 UT on day 346 of 1990 until 2052 UT on day 362. Subsequently, procedures were developed to recognize, correct, and prevent this sleep mode, thus minimizing its impact. However, there are occasional gaps in the electron data when the SWOOPS ion sensor, and other Ulysses experiments, were returning data.

3A. INSTRUMENT OPERATION-SUMMARY

Each spectrum takes 2 minutes to accumulate, but telemetry takes longer. When the spacecraft is being actively tracked and is returning data at its highest bit rate, spectra are returned every 2.3 minutes (low angular resolution mode) or every 5.7 minutes (high resolution mode). During playback of stored data, the spectral repetition rate is every 4.7 minutes (low angular resolution) or every 11.3 minutes (high resolution). These modes will be described in the next paragraph. For most of the mission, the instrument has been in high angula resolution mode, resulting in spectra every 5.7 minutes when the spacecraft is being tracked, or every 11.3 minutes for playback. The amount of spacecraft tracking depends on the mission phase.

3B. INSTRUMENT OPERATION-DETAILED DESCRIPTION

The electron analyzer is provided with a 22-level high voltage supply to cover a range of ion energies from 0.8 to 862 eV. At any given time, either the top 20 or bottom 20 of these voltage levels are used. Except from a period from instrument turn-on in November 1990 through December 3, 1990, the instrument has been in high-energy mode throughout the mission, resulting in an energy range of 1.6 to 862 eV. Prior to that time, the instrument alternated between low-energy (0.8 to 454 eV) and high-energy (1.6 to 862 eV) spectra.

The analyzer uses 7 channel electron multipliers (CEMs) to count electrons discretely over 95% of the unit sphere in look direction. For telemetry conservation, 2 out of every 3 spectra are "two-dimensionalized" onboard the spacecraft, that is the count rates are averaged over all 7 CEMs. These 2-d spectra thus return electron counts as a function of energy and spacecraft spin angle. The full 3-d spectra return counts as a function of energy, spacecraft spin angle, and polar angle (measured from the spacecraft spin axis, which points at Earth).

There are two angular resolution schemes which are ground commanded. In the high resolution scheme, which has been used for most of the mission, the 3-d spectra incorporate 32 spin-angle steps, for a total spectral content of 20 energies x 32 azimuths x 7 polar angles. The 2-d spectra incorporate 64 spin angle steps, for a total of 20 energies x 64 azimuths x 1 CEM-averaged polar angle (90 degrees from the spin axis). In the low resolution scheme, both 2-d and 3-d spectra incorporate only 16 spin angle steps, but provide a higher spectral repetition rate, as described in the previous section.

4. DATA REDUCTION ALGORITHMS

The first step in data reduction is determination of the spacecraft potential. This is done by identifying inflections in the angle-averaged energy spectra. Potential averages +6V, with higher values for low-density plasma and lower (but still positive) values for high-density plasma. A second inflection is also identified in the spectra, corresponding to the break between thermal ("core") and suprathermal ("halo") populations. The count rate arrays are then corrected for spacecraft potential and converted to phase-space density arrays using the "plane-parallel correction" (e.g., Scime et al., JGR, p. 14769, 1994), a correction which affects not only the energies but also the direction of motion of the measured electrons.

Plasma moments are then calculated by numerical integration of the velocity-weighted ion distributions. A total integration is performed from the spacecraft potential (corresponding to zero energy solar wind electrons) to the instrumental energy limit. Analogous core and halo integrations are performed for the parts of the distribution above and below the core-halo energy break point. Since the first few eV above the spacecraft potential are contaminated with photoelectrons on non-radial trajectories, it is necessary to use a biMaxwellian fit to the core distribution to fill in this part of the distribution; the total and core integration results are corrected based on this fit.

The integrations produce density, temperature components, velocity, and heat flux. At this time, only densities and scalar temperatures are being provided for archiving. The SWOOPS ion instrument provides much more accurate measurements of solar wind velocity; ion results should be used for velocities.

In general, the integrated density is similar, but not identical, to the sum of the core and halo densities. The lack of exact agreement is due to imprecision in separating the core and halo distributions. On rare occasions, gross discrepancies exist between the total density and the sum of core and halo; such data should be used with caution.

Uncertainties in the spacecraft potential determination can create errors in the density and temperature calculations. These problems are particularly severe when the solar wind is rarefied and cold, making it difficult to separate the photoelectron and thermal distributions. Occasionally, gross discrepancies appear between the SWOOPS ion and electron density determinations. When such discrepancies appear, the SWOOPS electron values (both density and temperature) are generally incorrect.

During some intervals, a "ripple" can be seen between the 2-d and 3-d densities and temperatures. This is an unavoidable effect of plasma anisotropies. The best procedure in this case is to compare the densities with those from the SWOOPS ion experiment (charge density = proton density + twice alpha density).

The URAP experiment aboard Ulysses operates a radio-frequency sounder which can distort the low-energy electron distributions. Spectra measured during sounder operations are flagged in the data and should be used with caution.

5. DESCRIPTION AND FORMAT OF DATA SUBMITTED TO THE NSSDC

The data provided to the NSSDC are the total, core, and halo electron densities and scalar temperatures at full instrumental time resolution, plus spacecraft position.

The time specified in the file is the center of each 2-minute spectrum. This time roughly corresponds to the center of the core distribution; the most appropriate time for the halo properties is roughly 30 seconds later.

The data files were created with Fortran on a Vax running VMS. Four files per calendar year are provided, with a naming scheme as follows:

U92183BAMELE.DAT corresponds to data starting on day 183 of year 1992.

They can be opened and read as follows:

```
      open (3, file='U92183BAMELE.DAT', status='old')

c       iyr             - year
c       idoy            - day of year (Jan 1 = 001)
c       ihr             - hour, UT
c       imin            - minute, UT
c       isec            - second, UT
c       idim            - dimension of spectrum (2 or 3)
c       isound          - sounder flag: 1=sounder off; 2=sounder on
c       sunsc           - sun-spacecraft distance, AU
c       hlat            - heliospheric latitude of spacecraft, degrees
c       hlong           - heliospheric (Carrington) longitude of spacecraft, deg
c       dene            - total electron number density per cubic cm
```

```
c       denc          - core electron number density per cubic cm
c       denh          - halo electron number density per cubic cm
c       tempe         - total electron temperature, Kelvins
c       tempc         - core electron temperature, Kelvins
c       temph         - halo electron temperature, Kelvins

        read (3, 1) iyr,idoy,ihr,imin,isec,idim,isound,sunsc,hlat,hlong,
       >            dene,denc,denh,tempe,tempc,temph

1       format(1x,i2,1x,i3,3(1x,i2),2(1x,i1),f7.4,2f7.2,6e13.5)
```

Missing or known bad density and temp data is replaced with a flag (1.e32) throu

7. FURTHER INFORMATION

For information on acquiring other types of data not provided to the the NSSDC, contact the Principal Investigator, Dr. John L. Phillips, at the Los Alamos National Laboratory, jlphillips@lanl.gov, 505-667-3101. Also contact Dr. Phillips for information on the reduction and analysis of data from the electron experiment. For information on the reduction and analysis of data from the positive ion experiment, contact Dr. Bruce E. Goldstein at the Jet Propulsion Laboratory, bgoldstein@jplsp2.jpl.nasa.gov, 818-354-7366.

Errata to Version 01 of SWOOPS Electron User's Guide

04/24/95: The SWOOPS electron data will shortly be staged by NSSDC to the NDADS near-line archive. All information in Version 01 of the users guide remains current except that the file names will be changed. Consult the NDADS SWOOPS data holdings file for information on the new file names.

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